

Development of a Supply Chain Technique for Identifying Border Supporting Cities in the Analysis of Processes of Inter-regional Spatial Integration

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Abstract- Inter-regional spatial integration contributes to supply chain activities for the solution of economic, environmental, socio-demographic, humanitarian and other problems of border areas through the implementation of inter-regional programs and projects. A major role in the development of integration processes is played by border supporting cities. Most researchers, characterizing the main criteria for the selection of supporting cities, call the geographical location, administrative independence, the level of development of urban infrastructure. This study examines the author's systematic approach to the development of criteria for assessing border supporting cities. The purpose of the study is to develop a supply chain strategy for classifying border cities as supporting and indicators for assessing their development level. The main research methods were the analytical, monographic, statistical methods, the score method, as well as the sum of places method (rating method) for conducting an aggregate assessment of the potential of integration cooperation. The authors of the study developed a supply chain methodology for identifying border supporting cities based on a systematic approach that takes into account economic and social indicators for assessing border cities. The results of testing the proposed methodology on the example of the Kazakh-Russian borderland showed that the border city, with a population of over 100 thousand people and located on the border territory, is or can in the future become a reference if there is an appropriate transport and geographical location and cross-border and integration cooperation potential. The application of this technique will allow in the future to increase the efficiency of regulation and management of interregional spatial integration processes.

Keywords- *interregional integration; border area; supply chain strategy; transport and geographical position; potential for integration cooperation.*

1. Introduction

Trends in supply chain management (SCM), such as the globalization of market economies, shorter product life cycles, digitalization, and multifaceted customer expectations, along with developments such as

resource scarcity, stricter regulatory requirements, and a more long-term focus, have led to the evolution of highly complex supply chains. In the context of globalization of the modern world economy, the object of scientific research is increasingly becoming the processes of inter-regional spatial integration at various levels (global, national, regional, etc.).

The increased interest in the role of border supporting cities in the processes of inter-regional spatial integration is caused, first of all, by the practical importance of these cities, which can not only ensure the territorial integrity of the country and the security of the state border, but also take an active part in resolving a wide range of international and domestic problems. On the other hand, border supporting cities are part of the economic space of the country and its regions and, undoubtedly, make their contribution to the economic development of the state.

Modern realities of interstate relations also require the formation and development of border supporting cities, taking into account their participation in international processes. Under these conditions, the prospect of developing border support cities increasingly depends on the willingness of individual states to identify and outline the real prospects for their integration with the border regions of neighboring countries.

Despite the great importance that border supporting cities play in the processes of interregional spatial integration, the concept of a border supporting city has not yet been developed. This situation necessitates the use of theories of spatial development for a comprehensive review and development of a unified approach to understanding the essence of the border supporting city.

In this regard, the purpose of this study is to refine and develop criteria and indicators that allow us to characterize the city as border and reference.

2. Literature Review

A number of practitioners, including the head of the World Trade Organization P. Lamy, considers interregional integration as a stage on the path to gradual inclusion in the international economy [1, 2], without which no state can effectively develop at present. According to the authors, the main subjects of

interregional spatial integration are border supporting cities.

The fundamental criterion for classifying a city as borderline is its geographical location, which assumes that the city is located on the border territory, as well as the fulfillment of effectively combined barrier and contact functions [3]. Contact means the ability to move (conduct) resources, goods, and people across national borders. Barrier means the ability of public authorities to protect public interests [4].

According to the Decision of the Council of the Heads of Government of the CIS "On the Concept of Interregional and Cross-Border Cooperation of the Member States of the Commonwealth of Independent States", [5] "... Border territory is part of the territory of the administrative-territorial unit of a CIS member state, the administrative border of which coincides with the state border Member State of the CIS. "

According to [6], frontier territories include: 1) "heart of the border" - territories that are highly dependent on the state border; 2) "intermediate territory" - territories that are in moderate or weak dependence on the state border; 3) "external zone" - territories that are slightly dependent on the state border and have an impact only in special circumstances.

Foreign scientists V. Velde and R. Martin identify four types of border territories, each of which is determined by functional dualism of the border, combining the functions of barrier and contact: 1) estranged - the absence of close border ties (border territories of Russia and Ukraine, Russia and Georgia); 2) neighboring - the presence of some economic and cultural interaction (border areas of Russia and Estonia); 3) interdependent - the presence of maximum interaction in the economic, social and cultural spheres, in the conditions of the still existing border (border areas of Russia and China); 4) integrated - the free movement of people, goods, cash flows and ideas (border areas within the customs union of Russia, Belarus, the Republic of Kazakhstan, Armenia and Kyrgyzstan) [3]. Note that border areas should strive to evolve from an alienated to an integrated type, which will ensure the sustainable development of their socio-economic indicators. In modern economic literature, there are many approaches to the category of a reference city.

According to L. Bozhko, "... in the role of the border supporting cities of the Republic of Kazakhstan, primarily, the centers of the border mesoregions should act: the city of Kostanay - the center of the Northern Mesoregion, the city of Aktobe - the center of the Ural Mesoregion, the city of Atyrau - the center of the Caspian Mesoregion, the city Ust-Kamenogorsk is the center of the Irtysh mesoregion " [5].

In the Strategy for the territorial development of the Republic of Kazakhstan until 2015, the main criteria for determining the supporting cities are the presence of the socio-economic potential of the city, its transport accessibility, close dislocation to potential internal or external sales markets, and the possibility of symmetrical development with large cities of neighboring states.

Many authors name the population among the main criteria of supporting cities. According to current standards, there is currently the following classification of cities according to population:

the largest - over 1000 thousand people;
large - from 250 to 1000 thousand people;
large - from 100 to 250 thousand people;
medium - from 50 to 100 thousand people;
small - from 10 to 50 thousand people.

In the framework of the theory of territorial development of Kazakhstan, a supporting city is "... an economically developed large city and a control center". According to the author, the functions of supporting cities can be performed by both large and largest, as well as large cities, the population of which is from 100 thousand people. Such cities, concentrated around city-forming enterprises of regional and republican significance, as a rule, make a significant contribution to ensuring the economic and national security of the state and can fully or partially carry the functions of supporting cities.

An important role in the development of inter-regional spatial integration is played by transport, since it is an efficient transport system that allows the movement of all types of resources between participants in integration processes. From this point of view, the economic-geographical position of the object (EGO), which the founder of the doctrine of the economic-geographical position of N.N. Baransky defined it as the relation of any object to outside its lying given, having one or another economic value [4]. In turn, one of the fundamental elements of EGO is the transport and geographical position (TGP), that is, the location of objects relative to communication lines [6]. The profitability of the economic and geographical position of the object can be regulated by improving the transport and geographical position (construction is expensive, the introduction of new modes of transport, the development of new routes, the optimization of the transport network). In this study, the objects are border cities, for which the ways of moving resources are of economic importance.

In order to consider the level of socio-economic development of a border city as a criterion for its categorization as "supporting," it is necessary to systematize the socio-economic indicators and give them a comprehensive assessment. [7] believes that "a potential category of cross-border cooperation" can be a "generalizing category reflecting the diversity of areas of cross-border cooperation" - a set of opportunities for developing a border territory due to its interaction with regions of neighboring countries ... these opportunities can be realized at a given or predicted level of development of productive forces under certain (favorable) political and socio-economic conditions". In his opinion, this indicator should include the natural resource, socio-economic and demographic potentials of the territory. [8] offers to assess the possibilities of cross-border cooperation of neighboring countries, determining the economic, demographic and natural resource potentials of cities and regions in comparison with the resource potential

and the level of economic development of the entire state.

[9] consider methodological approaches to assessing the economic development of the region on the basis of basic indicators of natural, labor, industrial, financial, investment, innovation and infrastructure potential.

Among Russian researchers there are following studies, which are of great interest: [10-18]. Among foreign researchers there are following studies, which are of great interest: [19-26].

According to M.N. Kondratieva's economic potential is "... a fundamental category generalizing the totality of factors determining the probabilistic state of a socio-economic system, depending on the degree of effectiveness of available resources and the conditions of existence of this system" [10]. According to the authors, from the point of view of the prospects for the participation of the border city in the processes of interregional integration, the use of the term "potential for integration cooperation" will be most appropriate.

3. Materials and Methods

In the course of the study, analytical, monographic, and statistical methods (including the method of arithmetic and weighted average) were used to establish criteria for classifying cities as cross-border and reference. To assess the transport-geographical position of border cities, it became advisable to use the scoring method, to conduct an aggregate assessment of the potential for integration cooperation, an integral indicator was

Table 1. Border cities of the Republic of Kazakhstan on the Kazakh-Russian border

Regions of the Republic of Kazakhstan	Border cities	The presence of common borders with the administrative-territorial units of the Russian Federation
Atyrau region	Atyrau, Kulsary	bordered in the northwest with the Astrakhan region
West-Kazakhstan region	Aksay, Uralsk	in the north it borders with Orenburg, Samara and Saratov, in the west - with the Volgograd and Astrakhan region
Aktobe region	Aktobe, Alga, Gem, Kandyagash, Temir, Khromtau, Shalkar, Emba	It borders in the north with the Orenburg region, in the south with the Karakalpak autonomy
Kostanay region	Kostanay, Arkalyk, Zhitikara, Lisakovsk, Rydny	borders on the Orenburg, Chelyabinsk, Kurgan regions
North-Kazakhstan region	Petropavlovsk, Taiynsha, Bulaevo, Mamlyutka, Sergeevka	in the north it borders with the Omsk, Kurgan and Tyumen regions
Pavlodar region	Pavlodar, Aksu, Ekibastuz	It borders in the north - with Omsk, northeast - Novosibirsk, in the east - Altai Territory
East Kazakhstan region	Ust-Kamenogorsk, Semey, Ridder, Zyryanovsk, Ayagoz, Shemonaikha, Zaysan, Kurchatov, Serebryansk, Shar	It borders in the east with China, in the north-east - with the Altai Territory and the Altai Republic

The next task of this stage of the study is the selection of those that can be classified as "support" from the border cities shown in table 1.

Taking into account the first criterion - the total urban population from 100 thousand people - the regional centers of Atyrau, Uralsk, Aktobe, Kostanay, Petropavlovsk, Pavlodar, Ust-Kamenogorsk, as well as the cities of Rudny (Kostanay region), Ekibastuz (Pavlodar region), Semey (East Kazakhstan region). In our opinion, as applied to the theory of the

calculated using the method of sum of places (rating method).

4. Results

Highly appreciating the fundamental and applied research of Russian and Kazakhstani scientists in the direction of the development of border areas and cities, it should be noted that there are shortcomings in the development of methods for determining border supporting cities and the degree of their participation and role in inter-regional spatial integration.

The author considers it appropriate to specify the criteria that will allow a comprehensive assessment of the degree and prospects of the city's participation in cross-border cooperation and inter-regional spatial integration (Figure 1).

Fig.1. Development of methods for the allocation of border supporting cities

5. Discussion

The frontier territory of the Kazakhstan-Russian border is the main administrative units of the Republic of Kazakhstan - areas that have common borders with the territory of the Russian Federation. The total length of the Kazakh-Russian border exceeds 7,500 km. Therefore, all cities located in the territories of the border Kazakhstan regions can be classified as border (table 1).

development of border territories, both the regional center and the city, on the territory of which the largest industrial facilities are located, play a significant role in the development of inter-regional spatial integration.

For a more detailed, qualitative assessment of the criterion of "population", we will use the indicators of the average population (with the study of the dynamic series for the period 2010-2018), population density, and also the specific gravity of the employed population in the study cities in the total population of the city (table 2).

Border cities	Population as of January 1, 2019, people	The average urban population for the period 2010-2018, people	Administrative-territorial area of the city, sq. Km	Population density, thousand people per 1 sq. Km, (as of January 1, 2019)	The proportion of the weighted average of the employed population in the population of the city, %	Integral Population Index
Atyrau	269704	205591	3500	0,077	68,29	5,258
Uralsk	330356	224908	209	1,581	55,40	87,59
Actobe	429462	383401	297	1,446	55,20	79,81
Kostanay	242997	224622	240	1,012	54,72	55,38
Rudny	115313	128260	176	0,655	57,48	37,65
Petropavlovsk	218056	209543	224	0,973	49,55	48,21
Pavlodar	333818	328685	352	0,948	56,10	53,18
Ekibastuz	133942	147808	188	0,712	53,11	37,80
Ust-Kamenogorsk	331597	365060	543	0,611	46,04	28,13
Semey	323199	308659	210	1,539	52,43	80,69

The average population in dynamics over the study period does not change significantly and in most cities has a tendency to increase.

The lowest population density are the cities of Atyrau (which is explained by a significant excess of the city's area compared to other objects), Rudny, Ekibastuz, Ust-Kamenogorsk (Figure 2).

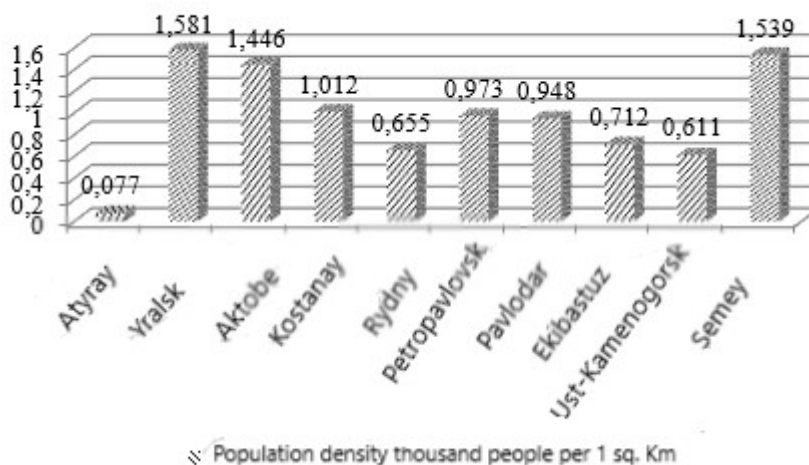


Figure 2. Analysis of border cities by population density (average for the period 2010-2018)

To assess the prospects for the participation of a border city in integration processes, it is advisable to analyze

the share of the weighted average of the employed population in the total population (Figure 3).

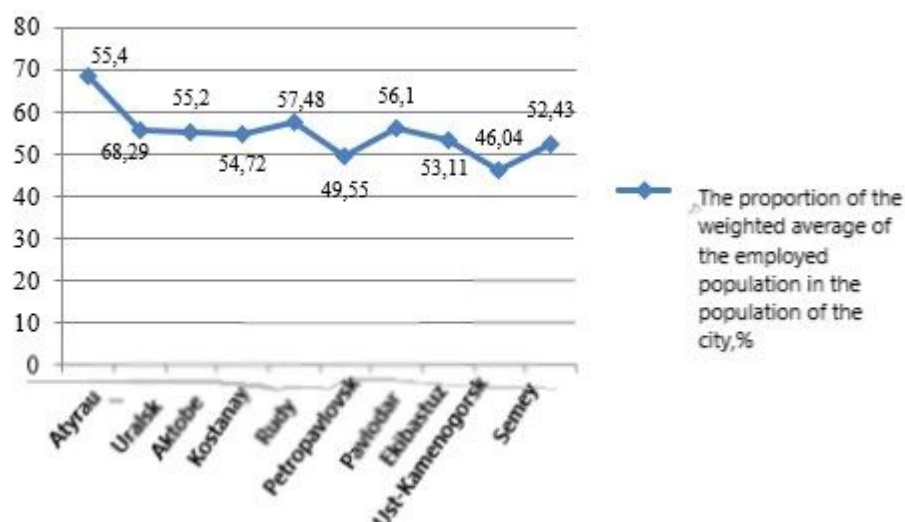


Figure 3. Analysis of border cities by the share of employed population in the total population of the city (average for the period 2010-2018)

The highest proportion, exceeding 70%, are the cities of Uralsk, Aktobe, Semey. In the cities of Petropavlovsk and Ust-Kamenogorsk, this figure is below 50%.

The integral indicator of the population of a border city that determines the possibility of its classification as a “support” can be determined by the formula (1):

$$ICH_{nas} = p \times [(N_g / N_r) \times 100], \quad (1)$$

Where: ICH_{nas} is an integral indicator of the population of a border city;

p - population density, thousand people for 1 sq. km;

N_g - the average employed population of the city, thousand people;

N_r - the average population of the city, thousand people.

The value of the integral indicator below 30 excludes the city from the category of “reference”. This indicator (ICH_{nas}) will allow to take into account the influence of both population density and the degree of employment of the city’s labor resources in the activities of industrial enterprises and in the integration processes taking place in the state (Figure 4).

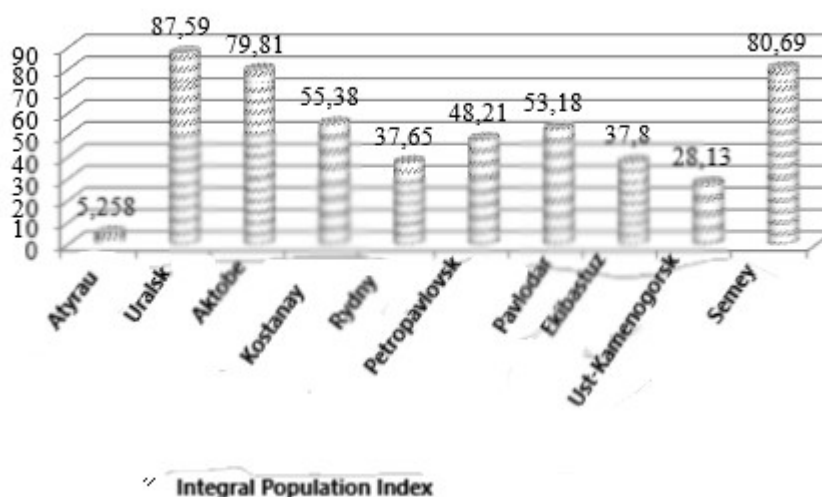


Figure 4. Analysis of the integral indicator of the population of border cities (average for the period 2010-2018)

The city of Ust-Kamenogorsk has an integral indicator of population below 30 (28.13), which is associated with both a high total population, which leads to a decrease in density, and a low specific gravity of the employed population. In the city of Atyrau, this indicator amounted to 0.164, however, the extremely low value of the indicator is explained by objective reasons - a significant excess (by an order of

magnitude) of the city’s area compared to other cities. Consequently, an analysis of the population shows that in this sample the city of Ust-Kamenogorsk cannot be categorized as “support”.

In the days of the Soviet Union, a developed network of airfields, railways and highways was built on the territory of modern Kazakhstan, which today provide reliable communication between the country with its

immediate neighbors and with more distant states. The main modes of transport connecting Kazakhstan with neighboring states are highways and railways.

The data presented in table 3, allow to characterize the transport and geographical position of border cities.

Table 3. Assessment of the transport-geographical position and development of the transport network of the border cities of the Republic of Kazakhstan at the Kazakh-Russian border

Border cities of the Republic of Kazakhstan	Distance to the nearest regional center of the Russian Federation (in a straight line), km	Travel time by road, hours	Availability of transport infrastructure						Availability of transport hubs
			airport	number of geographical points served by city airlines	Train Station	bus station	river transport	pipeline transport	
Atyrau	367 (Astrakhan)	4	+	12	+	+	-	+	roundabout Orsk - Atyrau - Aktoobe; highway Astrakhan - Atyrau - Aktau - Turkestan
Uralsk	236 (Samara)	2,6	+	7	+	+	+	+	(M-32 highway) with access to Samara
Aktobe	222 (Orenburg)	3	+	5	+	+	-	+	the intersection of the highway M-32, A-24 and A-27; (highway M-32) with access to Samara
Kostanay	260 (Chelyabinsk)	3,5	+	6	+	+	-	+	(highway M-36) with access to Chelyabinsk
Rydney	317 (Chelyabinsk)	4	-	-	+	+	-	+	-
Petropavlovsk	251 (Kurgan)	2,8	+	4	+	+	-	-	Northern corridor TAJM; Alma-Ata-Petropavlovsk highway with access to Omsk
Pavlodar	383 (Omsk)	4	+	7	+	+	+	+	M-38 highway with access to Omsk
Ekibastuz	386 (Omsk)	5	-	-	+	+	-	-	-
Ust-Kamenogorsk	590 (Gorno-Altaysk)	8,5	+	9	++	+	+	-	-
Semey	434 (Gorno-Altaysk)	7	+	4	++	+	+	-	M-38 highway with access to Omsk

To study this criterion, we propose a method of ball scoring, which, despite some subjectivity, seems to be the fastest and most convenient. The objectivism of this method can be increased in the presence of quantitative indicators. In particular, to estimate the distance between paired border cities, we use the method of statistical grouping by the method of equal intervals with the assignment of a specific score to each statistical group.

The studied cities are located at a distance of 200 to 600 km from the nearby city-regional centers of the Russian Federation. To score this indicator, the following scale is proposed:

- distance from 200 to 300 km - 4 points;
- distance from 300 to 400 km - 3 points;
- distance from 400 to 500 km - 2 points;
- distance from 500 to 600 km - 1 point.

The most accessible from the point of view of proximity to Russian cities are Uralsk, Aktoobe,

Kostanay, Petropavlovsk (less than 300 km and 3-4 hours on the highway). The most distant cities are Ust-Kamenogorsk and Semey - respectively 434 and 590 km from the capital of the Altai Territory of the city of Gorno-Altaysk (more than 7 hours on the road).

The level of development of the transport network is determined by the presence in the city of transport infrastructure: airports, railway stations, bus stations, oil and gas pipelines, as well as the development of water, in particular river transport.

All studied cities have an airport with international status, with the exception of the city of Rudny. The largest number of airlines is at the airports of Atyrau (12) and Ust-Kamenogorsk (9). The airport in Ekibastuz is currently closed and is closed. Also, in every city there are railway and bus stations. In the cities of Ust-Kamenogorsk and Semey 2 railway stations.

River transport is part of the transport and communication complex of Kazakhstan. The main infrastructure units for river transport are ports and marinas located on the main waterways. The main

active river ports in the Irtysh river basin from the studied list of border cities are Pavlodar, Semey, Ust-Kamenogorsk. There are 2 river ports on the Ural River: the port of Uralsk and the port of Atyrau, which has the status of a wellhead. There is a mechanized marina in the city of Petropavlovsk on the Ishim River. River ports and mechanized marinas are specialized enterprises, provided with a mooring front, transshipment mechanisms and storage facilities, the necessary infrastructure.

Kazakhstan has significant proven oil and gas reserves. About 10,715 km of oil and gas pipelines are used to transport hydrocarbons in the republic. As a legacy of the Soviet economic system, oil extracted in the west is transported through Russia to world markets, and domestic demand in the east is met through imports from Siberia. In addition, most of the existing pipelines were built several decades ago and were intended to fulfill the goals of the former Soviet Union, and not Kazakhstan as an independent state. The Omsk-Pavlodar-Shymkent-Chardzhou pipeline located in the

east crosses the country from north to south, but most of the pipelines are located in the western part of the country. Existing pipelines deliver oil to one of three Kazakhstani refineries (in Atyrau, Shymkent and Pavlodar), to southern Russian or Ukrainian refineries, as well as to the world market. The main international route for transporting Kazakhstani oil is the Atyrau-Samara export pipeline.

The border cities, except for Rudny, Ekibastuz and Ust-Kamenogorsk, have on their territory the junction points of several types of transport that jointly carry out operations to service transit, local and urban transportation of goods and passengers with access to large Russian cities. Petropavlovsk is part of the Northern Corridor of the Trans-Asian Railway (TAR).

A scoring of the criterion “transport-geographical position and development of the transport network” demonstrated that the cities with the highest number of points were Uralsk and Aktobe, which have an economically advantageous transport-geographical position and a developed transport network (table 4).

Table 4. Scoring of the transport-geographical position and development of the transport network of the border cities of the Republic of Kazakhstan on the Kazakh-Russian border

Border cities of the Republic of Kazakhstan	Distance to the nearest regional center of the Russian Federation (in a straight line), km	Availability of transport infrastructure *					Availability of transport nodes	Total points
		airport	Train station	bus station	river transport	pipeline transport		
Atyray	3	1	1	1	0	1	2	9
Uralsk	4	1	1	1	1	1	1	10
Aktobe	4	1	1	1	0	1	2	10
Kostanay	4	1	1	1	0	0	1	8
Rudny	3	0	1	1	0	1	0	6
Petropavlovsk	4	1	1	1	0	0	2	9
Pavlodar	3	1	1	1	1	1	1	9
Ekibastuz	3	0	1	1	0	0	0	5
Ust-Kamenogorsk	1	1	2	1	1	0	0	6
Semey	2	1	2	1	1	0	1	8

* 1 point is assigned if there is a transport point or a separate mode of transport in the city

The least points are observed in the cities of Rudny, Ekibastuz and Ust-Kamenogorsk. The low score of Ust-Kamenogorsk is explained by its greatest remoteness from the territory of the Russian Federation.

Thus, the analysis of cities by TGL and the level of development of the transport network indicates that the city of Ekibastuz, which received the lowest rating of transport development, which amounted to 5 points, cannot be classified as “support”.

We propose to use the term “potential for integration cooperation” as a criterion for classifying a border city as a “supporting one”. Summarizing the accumulated experience, it can be argued that the potential for integration cooperation is a combination of factors that determine the role of the administrative-territorial unit (city) in the processes of inter-regional spatial integration, depending on the availability and efficient use of resources. This criterion will include indicators that allow a comprehensive assessment of the prospects for the participation of border cities in interregional spatial integration (table 5).

Table 5. Basic indicators for assessing the potential for integration cooperation of the border cities of the Republic of Kazakhstan on the Kazakh-Russian border

Structural component	Indicators
Natural resource potential	Area per capita, sq. Km per 1000 people
Human potential	The number of economically active population, thousand people Unemployment rate, % Average monthly nominal wage per employee, tenge
Production potential,%	Volume of industrial production, million tenge per capita The number of active subjects of small and medium-sized enterprises, mln. Tenge per capita Investments in fixed assets,%
Social development potential	Number of hospital beds, units per 1000 people The share of students in universities in the total population,% The value of the living wage, tenge

Unfortunately, the information provided by the statistical authorities in the studied border cities is far from complete (in contrast to the data provided at the regional level and, especially, at the republican level). In this regard, when performing the assessment, difficulties arose in determining the duration of the time series. The most complete is the analysis of the time series for the period 2014-2017, information on which is available in the relevant statistical reports, from the perspective of retrospective dynamics.

In assessing the potential for integration cooperation in border cities, the advantage was given to relative indicators as more informative and reliable.

To obtain an aggregate assessment [7] offers various methods for constructing integral indicators, including alternative ones: the sum method, the method for the sum of the weighted average arithmetic group indicators, the method for the product of the weighted average geometric group indicators, the distance method, the method of summing places.

In this study, we use the method of sum of places (rating method), in which preliminary ranking of all the studied objects by individual indicators is performed, that is, their ranking by the degree of manifestation of a

particular quantitative indicator. Each border town is assigned a specific value of the i indicator x_{ij} which corresponds to the indicator of its place among others. The final value of the aggregate assessment (integral indicator) is determined using weighting coefficients according to the formula (2):

$$A_i = \sum_{j=1}^n a_{ij} * x_{ij} \quad i = 1, 2, 3, \dots, n, \quad (2)$$

where A_i is an aggregated assessment of the potential for integration cooperation of border cities;

a_{ij} is the weight coefficient of the i indicator;

x_{ij} is the actual and base value of the i indicator on the j object.

In the course of assessing the significance of the desired indicator, it is allowed to establish equal weights for all, which, in turn, will eliminate the subjectivity of the expert assessment of weights [9]. Using formula (2), an aggregate assessment of the potential of integration cooperation was obtained; an aggregate assessment of the potential of integration cooperation (table 6).

Table 6. Aggregated assessment of the potential for integration cooperation of the border cities of the Republic of Kazakhstan on the Kazakh-Russian border

Border cities Republic of Kazakhstan	Assessment of natural resource potential	Human Assessment	Assessment of production potential	Social Development Potential Assessment	Cumulative aggregate rating
Atyrau	10,00	24,25	25,75	22,75	92,75
Uralsk	3,25	16,50	14,00	19,50	53,25
Aktobe	2,75	23,75	21,00	16,75	64,25
Kostanay	4,50	13,00	14,50	24,00	56,00
Rydney	7,75	17,25	18,00	11,25	54,25
Petropavlovsk	5,50	16,00	13,00	15,50	49,50
Pavlodar	6,50	23,25	23,50	14,75	68,00
Ekibastuz	7,75	17,75	24,50	8,25	58,25
Ust-Kamenogorsk	9,00	20,75	21,75	14,50	66,00
Semey	1,50	15,00	12,5	17,25	46,25

The clear leader in almost all indicators (with the exception of a slight lag behind the first place in terms of social development) is the city of Atyrau, which undoubtedly is one of the largest, industrially

developed regional centers of Kazakhstan and plays a leading role in the formation and development of cross-border cooperation of the Caspian Mesoregion (Figure 5).

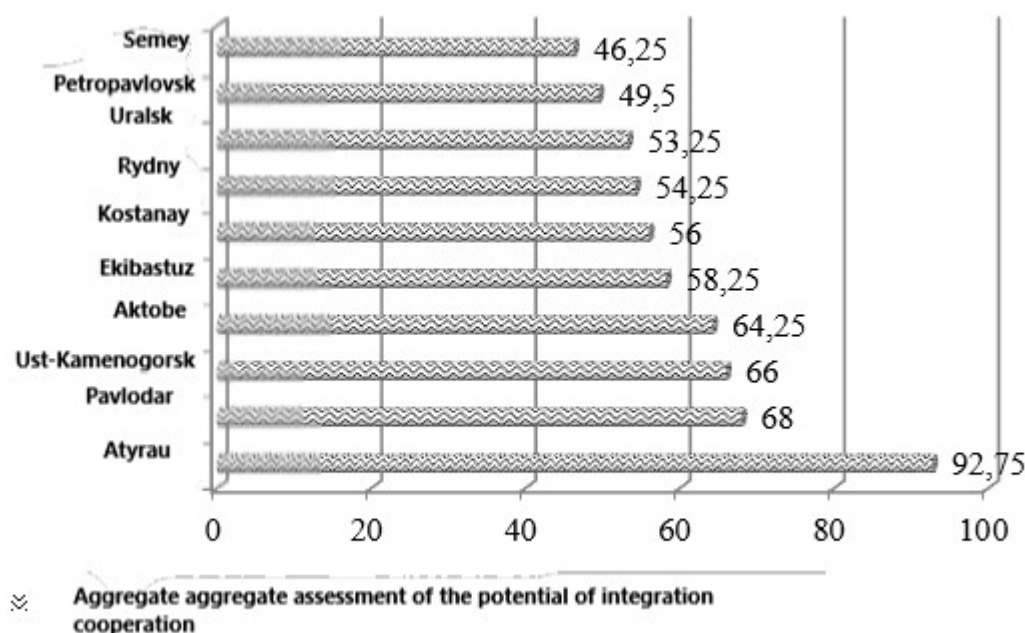


Figure 5. Aggregated assessment of the potential for integration cooperation in the border cities of the Republic of Kazakhstan on the Kazakh-Russian border

The lowest rating was given to the cities of Semey and Petropavlovsk. The highest level of natural resource

potential was noted in the cities of Atyrau and Ust-Kamenogorsk (Figure 6).

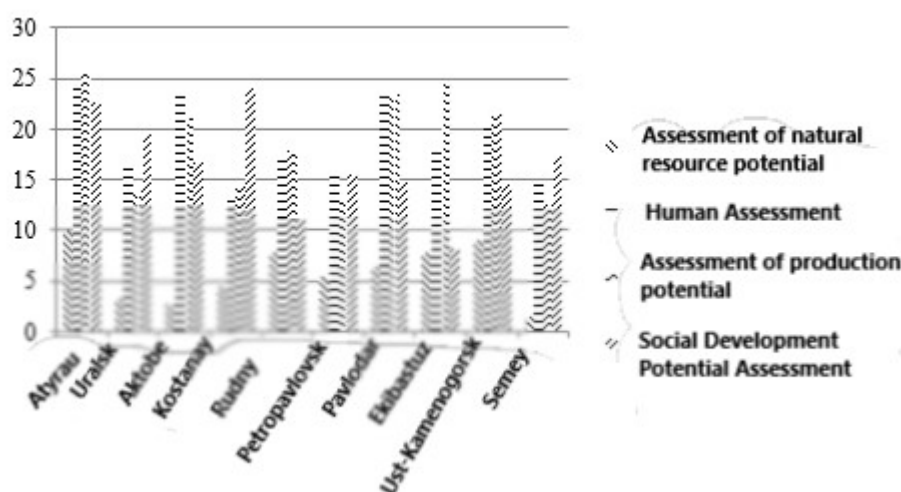


Figure 6. Aggregated assessment of the potential for integration cooperation of the border cities of the Republic of Kazakhstan at the Kazakh-Russian borderland (by structural components)

Human potential was highly appreciated in the cities of Atyrau, Aktobe, Pavlodar and Ust-Kamenogorsk. A fairly high level of production potential is observed in the cities of Atyrau, Aktobe, Ekibastuz, Pavlodar and Ust-Kamenogorsk. The city of Ekibastuz received a high rating of this indicator, since the unique coal mining enterprise Bogatyr Komir LLP (Vostochny open pit mine), two large state-owned power plants, and Kazakhstan Carriage Building LLP operate in this city. The city of Rudny also has a high production potential due to the location on its territory of the largest iron ore deposit [27-30]. The highest rates of social development were distinguished by the cities of

Kostanay, Atyrau and Uralsk. In Kostanay, medical services are well developed (compared to other cities under study), and in Uralsk, a higher education system (the highest percentage of students in higher education in the total population).

Aggregated potential assessment, below 50 units, means the exclusion of the city from the category of "reference". Such an assessment was received by the cities of Semey (46.25) and Petropavlovsk (49.5).

The practical results of the study of border cities according to the developed methodology are presented in table 7.

Table 7. Practical results of testing the methodology for highlighting the border supporting cities of the Republic of Kazakhstan on the Kazakh-Russian border

Border cities	Selection criteria for border supporting cities				Summary
	Population size		TGL and the development of the transport network (more than 50% of the score)	The potential of integration cooperation (more than 50% of the accumulated number of units)	
	quantification (from 100 thousand people)	quality assessment (over 30)			
Atyrau	+	+	+	+	+
Uralsk	+	+	+	+	+
Aktobe	+	+	+	+	+
Kostanay	+	+	+	+	+
Rydney	+	+	+	+	+
Petropavlovsk	+	+	+	—	+
Pavlodar	+	+	+	+	+
Ekibastuz	+	+	—	+	+
Ust-Kamenogorsk	+	—	+	+	+
Semey	+	+	+	—	+

Initially, border cities corresponding to the first criterion were identified for the study - the total population of 100 thousand people. The city of Ust-Kamenogorsk does not meet the criteria for a qualitative assessment of the population, characterized by both a low population density and a low specific gravity of the employed population in the total number.

The low level of TGP and the development of the transport network compared to other cities is characterized by the city of Ekibastuz, which does not meet the second criterion. The lowest assessment of the potential for integration cooperation was received by the cities of Semey and Petropavlovsk, thus not meeting the third criterion (table 8).

Table 8. Border cities that do not meet certain criteria for categorization as “supporting”

Evaluation criterion	Border cities not included in the category of “support” by this criterion
Population size: quantification quality assessment	– Ust-Kamenogorsk
Transport and geographical location of the city and the development of the transport network	Ekibastuz
Potential for integration cooperation	Semey and Petropavlovsk

Based on the position that the category of “reference” includes border cities that meet the first criterion and at least two additional criteria, all the cities under study are reference. This proves the assumption expressed above that a border city, with a population of over 100 thousand people and located on the border territory, is or can in the future become a reference if there is an appropriate transport and geographical location and the potential for cross-border and integration cooperation.

6. Conclusion

Organizations are influenced by both internal and external factors (such as government, community, investors, customers, suppliers, and employees) to adopt sustainable supply chain initiative. Modern researchers on the problems of the development of border areas and inter-regional spatial integration offer a variety of criteria for the allocation of border supporting cities. An analysis of the existing methodological approaches to the assessment of border supporting cities and our own studies have allowed the author to systematize, refine and supplement its various indicators.

The methodology proposed by the author is based on a systematic approach that allows classifying assessment criteria and using both economic and social indicators for assessing border cities, the main purpose of which is to effectively bring together the production potentials of the regions of neighboring states and ensure economic security of their territory.

A distinctive feature of the developed methodology is the author's approach to the calculation of integral indicators, among which it is proposed to calculate indicators of a qualitative assessment of the population and the potential for integration cooperation. The indicator of a qualitative assessment of the population is calculated using a multiplicative approach and allows us to assess the prospects for the participation of a border city in integration processes. The indicator of the potential of integration cooperation is calculated using the additive approach and allows you to determine the role of the administrative-territorial unit (city) in the processes of inter-regional spatial integration, depending on the availability and efficiency of use of resources (natural, human, industrial and social).

Managing supply chains is more than the efficient movement of goods. Testing the developed methodology on the example of the border cities of the Kazakh-Russian border region led to the conclusion that the border city, which belongs to the category of large, large or largest, is or can in the future become a reference if there are appropriate conditions for integration cooperation.

– The application of this technique to highlight the border supporting cities will allow, firstly, to carry out the convergence of the interests of the authorities, business and society in order to achieve the common goal of economic integration; secondly, to concentrate state management of integration processes in the “poles of growth”, which will be the border supporting cities.

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